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Low-temperature phase separation of a binary liquid mixture in porous materials studied by cryoporometry and pulsed-field-gradient NMR

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Abstract

The low-temperature liquid-liquid phase separation of the partially miscible hexane-nitrobenzene mixture imbibed in porous glasses of different pore sizes from 7 to 130 nm has been studied using 1H NMR (nuclear magnetic resonance) cryoporometry and pulse field gradient NMR methods. The mixture was quenched below both its upper critical solution temperature (T cr) and the freezing point of nitrobenzene. The size distribution of frozen nitrobenzene domains was derived through their melting point suppression according to the Gibbs-Thompson relation. The obtained data reveal small initial droplets of nitrobenzene surrounded by hexane, which are created as the temperature is decreased below Tcr and which thereafter coalesce by a droplet-diffusion mechanism. The inter-relation between the pore size and the found size distribution and shapes of nitrobenzene domains is discussed, as well as several aspects of molecular self-diffusion.

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